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FEDERAL COMMUNICATIONS COMMISSION
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)

Replacement of Part 90 by Part 88)
to Revise the Private Land Mobile)
Radio Services and Modify the)
Existing Policies Governing Them)

PR Docket No. 92-235

To: The Commission

COMMENTS OF ADVANCED MOBILECOMM, INC.

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SUMMARY

Advanced Mobilecomm, Inc. ("AMI"), as an experienced provider of private land mobile radio services and as a participant in the earlier inquiry into "refarming," welcomes the Commission's further initiatives in the instant docket which seeks, inter alia, to increase channel capacity in the frequency bands below 512 MHz. AMI is gratified to see that the Commission's proposed policies and rules appear to reflect some of the suggestions put forth in AMI's comments in the earlier

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Advanced MobileComm, Inc. ("AMI"), pursuant to the

I. INTRODUCTION AND STATEMENT OF INTEREST

Advanced MobileComm, Inc. (AMI) participated extensively in the Commission's earlier proceeding dealing with "refarming"² and welcomes this opportunity to offer further assistance to the Commission in its deliberations seeking more efficient usage of the PLMR bands below 512 MHz.

Together with its operating affiliates, AMI and its principals are actively involved in the provision of fixed and mobile telecommunications throughout the United States. AMI is also involved in the provision of radio paging services in the United Kingdom and Spain. AMI's parent company, FMR Corp.,³ operates a complex telecommunications infrastructure throughout the United States, which includes, in partnership with TCI and Cox, a state-of-the-art fiber optic telecommunications network (Teleport).

AMI, through its operating affiliates, is one of the nation's largest and leading providers of Specialized Mobile Radio (SMR) services. AMI has strongly and consistently supported the introduction of spectrally-efficient communications technologies throughout the U.S. by, among other things, (1)

² Notice of Inquiry ("NOI"), PR Docket No. 91-170, 6 FCC Rcd 4125 (1991).

³ FMR Corp. together with its subsidiary companies (collectively "Fidelity Investments") provides investment, management and shareholder services for retail and institutional investors; provides discount brokerage services; manages and develops real estate; and invests in emerging businesses, including AMI. Fidelity Investments manages over \$200 billion in assets and is the largest privately held manager of mutual funds in the United States.

participating extensively in the Commission's proceedings dealing with the introduction of narrowband technology in the 220-222 MHz band, (2) requesting and receiving from the Commission the necessary regulatory authority to convert a number of its SMR systems to a more spectrally efficient, digital technology, (3) participating extensively in the NOI-stage of this proceeding as noted above, and (4) conducting experiments relating to the development of Personal Communications Services and participating in the associated Commission proceedings dealing with PCS.

In its Comments and Reply Comments in the NOI-stage of this proceeding, AMI, among other things, (a) set forth a detailed six-step program to refarm the spectrum below 470 MHz and (b) strongly urged the Commission to adopt an efficiency standard for the refarming activity on the basis of a minimum of five times improvement. AMI is gratified to see that elements of the Commission's proposed policies and rules appear to reflect some of the suggestions put forth in its six-step program. However, AMI is very concerned that the Commission, in its NPRM, is demonstrating some hesitancy in moving decisively in the direction of 5 kHz rather than wider (e.g., 6.25 kHz) channelization.

In this NPRM-stage of the proceeding, AMI will limit its comments to the issue of channel size which the Commission itself recognizes is a "critical element" of its proposal.⁴ It will do so because, for the reason discussed in detail below, unless the

⁴ NPRM, Appendix A at page 14.

Commission adopts a 5 kHz channel size for all of the bands at issue, it will have lost a major, nearly risk-free, opportunity to achieve significant additional improvements in spectral efficiency in the PLMR bands.

II. THE COMMISSION SHOULD ADOPT 5 KHZ RATHER THAN 6.25 KHZ AS THE "BENCHMARK" FOR THE CHANNELIZATION PLANS FOR ALL OF THE BANDS AT ISSUE.

In its Comments and Reply Comments in the NOI, AMI suggested that the efficiency standard for the refarming activity should be on the basis of a minimum of five times improvement and stated that such efficiencies could be accomplished with Amplitude Compandored Sideband (ACSB) or Time Division Multiple Access (TDMA). AMI noted that the former could provide five 5 kHz channels and the latter six channels (time slots) in each 25 kHz channel to be refarmed. In its NPRM, however, the Commission has stated that it proposes to "...reduce channel spacing to 5 kHz for low power mobile frequencies in the 72-76 MHz [band] and for all frequencies in the 150-174 MHz bands...[and to]...reduce channel spacing in the 421-430 MHz, 450-470 MHz and 470-512 MHz bands to 6.25 kHz."⁵ We are also aware, from the Commission's Refarming Roundtables and other sources, that various parties are continuing to advocate 6.25 kHz channel spacing as the "lowest common denominator" for channelization plans in all of the bands.

At the outset, we should state that AMI remains in favor of the notion that licensees should be able to choose either

⁵ NPRM, Appendix A at page 13.

frequency division multiple access (FDMA) with either analog or digital transmissions, or digital TDMA technology, as long as minimum standards of spectrum efficiency are met. In particular, AMI continues to support the idea that licensees should be able to group together contiguous channels of the minimum bandwidth and use them either on an FDMA basis or on a TDMA basis, subject only to minimum out-of-band emission and spectrum efficiency standards. AMI supports these positions because it believes that the public interest is best served by allowing PLMR users and their equipment/system suppliers the maximum flexibility to interact in the marketplace to make the correct technological choices.

However, AMI believes that the ultimate channel size chosen by the Commission should be 5 kHz for the following four reasons:

First, a 5 kHz channel spacing size and an occupied bandwidth of 4 kHz represents a good match to the bandwidth required for voice communications in either the analog or digital mode. Because voice communications is apt to remain the predominant form of mobile communications, it is wasteful to create a channel size greater than that required for voice. Unlike users of fixed services, users that are moving about in vehicles or on foot rarely have the ability to exchange anything except the most routine of data messages because of the limitations of keyboard entry. Therefore, the growth of non-voice services is speculative at best, and in any event, the use of modern data compression and high level modulation techniques

permits the transmission of data traffic at sufficient speeds (e.g., 9.6 kbps) for all but the most specialized applications, such as the transmission of slow scan video.⁶

The Commission should not let these extremely specialized, speculative applications drive its decision regarding the choice of an ultimate channel size because, to do otherwise, would structurally build into the channelization plan significant inefficiencies for the handling of voice and other nominally "voice-bandwidth" traffic. Moreover, in terms of data communications capacity, the difference between a maximum basic channel spacing of 5 kHz and 6.25 kHz is not apt to be significant for these specialized applications in any event. Finally, if the Commission adopts the notion of allowing users to group or stack the basic channels together on a real-time or more permanent basis (as long as minimum standards of spectrum efficiency are achieved), users with specialized applications can

⁶ The data capacity of a 5 kHz channel is considerably higher than the capacity of most existing PLMR systems using 25 kHz channels. Several manufacturers presented information on the data capacity of 5 kHz channel radios at the Commissions recent Refarming Technical Roundtable.

For example, the paper submitted by Peter Hilton of Securicor PMR Systems discusses the development of commercial land mobile equipment for use in 5 kHz channels to meet MPT 1376, the UK co-existence specification for UHF and VHF private mobile radio systems. In the discussion the author states that: "It [the equipment] is capable of superior performance carrying either analogue voice, or digital data at rates of 9.6 kilo bits per second and beyond." At the same meeting, Kazuhiro Daikoku of NTT provided information on the development of "Real Zero Single Sideband" ("RZ SSB") radios for use in 5-kHz-spaced channels. According to his paper, field test results were excellent for G3 [Group III] facsimile at both 4.8 and 9.6 kbps signaling rates.

utilize wider total bandwidths as needed.⁷

Second, in general, in the FDMA mode,⁸ a basic channel spacing of 5 kHz provides 25 percent more channels in a given amount of spectrum than does 6.25 kHz. Furthermore, in the trunked mode of operation, adding more channels in a trunk group adds a disproportionate amount of additional capacity and this effect of increased trunking efficiency is greatest with small trunk groups. More specifically, for a given quality of service (i.e., blocking probability), converting to five channels rather than four channels per existing 25 kHz channel creates substantially more capacity in terms of throughput above the 25 percent gained from the narrower channels. This is especially true when one channel is used as a signaling channel. This increased spectrum efficiency translates directly into more

⁷ AMI has urged third-party provision of service and exclusive channel assignments in the refarming bands precisely because it create incentives for providers to offer "bandwidth-on-demand" services. Just as existing trunked SMR systems operating at 800/900 MHz assign fixed increments of spectrum (channels) to end users on an "as needed" basis, advanced bandwidth-on-demand systems will allow variable increments of capacity (bandwidth) to be assigned to more closely match user needs on a real-time basis. In a TDMA system, this can be done by assigning additional time slots to a user on a "call-by-call" basis.

⁸ AMI believes that there is a role for both FDMA and TDMA systems in the PLMR bands because the former has clear advantages in certain applications. For example, "talk around" is a capability that is inherently easier to implement with FDMA systems than it is with TDMA systems. FDMA also provides a well proven mode of access that can easily be carried over to narrower channels and the FDMA mode does not require that channels be contiguous. Finally, TDMA systems provide a degree of "overkill" for certain applications with low cost and minimal capacity and capability requirements, especially in areas with low user densities.

capacity per base station site and hence provides additional economic incentives for users to make the switch. According to the Commission's own analysis, the bands at issue in this proceeding provide the bulk of the current PLMR service capacity.⁹ the increment in capacity associated with 5 kHz rather

kHz. There are indications that such increments may not only be technically feasible for relatively low speed data, but for voice as well. ~~Despite the possibility of even narrower channels~~ AMT

considered and when the current and expected future state-of-the-art is taken into proper account.

First, some advocates of greater bandwidth have argued that 5 kHz (and even 6.25 kHz channels) are too narrow to support certain emerging data applications, principally the transmission of facsimile messages and images such as photographs or "mug shots." AMI believes this argument is without merit because:

- (a) Existing or immediately foreseeable narrowband (i.e., 5 kHz) radio designs for use in the 150 MHz and 220 MHz bands in the U.S. and for other bands elsewhere in the world (notably the United Kingdom and Japan) are capable of operating at data speeds comparable to or exceeding the transmission rates achieved by today's equipment operating in 25 kHz channels. As noted earlier, 9600 bps and higher data rates in 5 kHz channels were discussed at length in the Commission's recent Refarming Technical Roundtable. Moreover, a recent article by authors from Motorola projects a 3.5 bps/Hz modulation efficiency for the 1992-1994 time frame which also translates easily into a data speed of well over 10 kbps in a 5 kHz channel.¹¹
- (b) With stacking, speeds much greater than 10 kbps (or other improvements in data performance such as better bit-error-rates) can be achieved for those atypical applications requiring it and, as explained earlier, a 5 kHz channel spacing size permits more fine grained adjustments to more exactly meet the actual requirement in terms of higher data speeds.
- (c) There is relatively little difference in terms of the data capacity of 6.25 kHz versus 5 kHz channels. For example, neither will support maximum Group III facsimile transmission rates even with 4-level QAM modulation. In either case, stacking would permit the achievement of the highest speeds associated with Group III facsimile and the transmission of photos.

Hence data capacity alone is no reason to favor 6.25 kHz channels

¹¹ Davidson, Allen and Larry Marturano, "Impact of digital techniques on future LM spectrum requirements," IEEE Vehicular Technology Society News, May, 1993, page 14.

over 5 kHz--especially given the overwhelming advantages of 5 kHz spacing as described earlier.

Second, the Commission itself argues that "The 6.25 kHz channelization is as or more efficient than the 5 kHz because the 6.25 kHz channelization permits the creation of over 1700 additional offset channels for low power use in the 450-470 MHz band."¹² AMI is unclear as to the basis for this argument since it is presented mainly as a conclusion without significant discussion. Nevertheless, AMI is well aware of the rapid growth and importance of the use of low power, offset channels and the need to accommodate such applications within the spectrum resource.

The use of existing offsets in low power applications is predicated on the fact that, in today's FM systems, the transmitted energy tends to be concentrated in the center of the channel rather than at the edges of the occupied bandwidth. Thus offset channels, especially low power systems, are less likely to cause objectionable interference. Offset channels, however, should receive interference protection from the regularly assignable channels under the Rules (and vice versa). The emissions of emerging digital systems utilizing higher level digital modulation, on the other hand, tend to fill out the entire occupied bandwidth more evenly thus making the use of offsets somewhat problematical.

For these reasons, and given the growing importance of low

¹² NPRM, Appendix A, at page 2, f.n. 2.

power, more localized communications, it is AMI's belief that, in the long term, such applications should be migrated to the 2 GHz band where both licensed and unlicensed, low power, limited range personal communications services are being contemplated by the Commission.¹³ The 2 GHz band is ideal for such applications and, because mixing high power systems with low power systems creates fundamental engineering challenges,¹⁴ it would be better public policy to reserve the bands at issue in this proceeding to relatively high power applications. Furthermore, to the extent such low power applications are accommodated within the bands at issue, users would be better served from an interference standpoint if they were assigned regular channels within an overall allocation scheme based upon 5 kHz channelization as described above.

Third, some advocates of greater bandwidth have argued that narrowband technology is "unproven." As AMI noted at the time it made its original comments in this proceeding, technology was already available to support at least a five times improvement in spectrum efficiency. As pointed out by the II-Morrow representative at the Commission's recent Refarming Technical

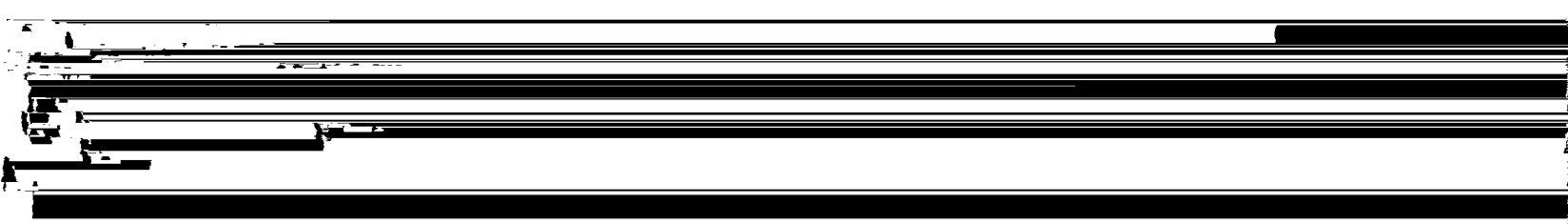
¹³See Amendment of the Commission's Rules to Establish New Personal Communications Services (Notice of Proposed Rulemaking), 7 FCC Rcd. 5676, 5693-94 (1992) ("PCS NPRM").

¹⁴ When high and low power applications are mixed in channels located quite close to each other, the dynamic range of desired and undesired signals tends to increase; thus, for example, adjacent channel interference becomes more difficult to control. And, of course, if it is not adequately controlled, spectral efficiency can suffer since adjacent channels may not be usable in the same general area.

Roundtable, the very presence of five manufacturers of 5 kHz narrowband equipment demonstrates that the technology is feasible.

In addition to favorable reports by SEA, Uniden, and II-Morrow at the meeting, the Securicor representative reported on the U.K. government's commitment to moving from 12.5 kHz channel spacing to 5 kHz spacing based upon exhaustive, objective tests carried out by government laboratories.¹⁵ The representative from NTT in Japan reported on similar activities. Thus the record simply does not support the notion that narrowband technology is unproven or that there are too few manufacturers of such equipment. Indeed, it is somewhat ironic to note that what was missing at the meeting was manufacturers of 6.25 kHz equipment. Hence, there is absolutely no reason to favor 6.25 kHz equipment over 5 kHz equipment on the basis of "proven technology," technical feasibility or equipment availability.

Fourth, some advocates of greater bandwidth have also argued that antenna combining problems would be aggravated by narrower channels. While we have heard such claims, we have seen little in the way of technical justification for the assertion. Linear power amplifiers that are required for more spectrally efficient,



low level combining highly feasible.¹⁶ More specifically, AMI, based upon its considerable engineering experience, does not believe there are significant differences in combining 5 kHz channels compared with 6.25 kHz channels. Hence, there is no reason to favor 6.25 kHz equipment over 5 kHz equipment on the basis of ease of combining.

Fifth, and finally, some advocates have argued against 5 kHz channelization on what we believe is the rather specious basis that it would prevent 6.25 kHz systems from being utilized, or if such equipment were to be utilized, that it would require the

APCO Project 25 publication¹⁷ submitted with the reports furnished to the Commission in conjunction with the recent Refarming Technical Roundtable notes that, "If the project proceeds at its current rate, the complete standard of 12.5 kHz will not be completed until the spring of 1994." The note goes on to state, "That means there cannot be consideration of a 6.25 kHz standard until the summer of 1994." It is clear that, no matter how meritorious its objectives, the APCO Project 25 process is not keeping up with today's rapid pace of technological innovation.

Given the rapid pace of technological innovation outside the U.S. and, in particular, the commitments to move toward 5 kHz channels in PLMR services in the U.K. and Japan, AMI believes it would be foolhardy for the Commission to harness the commercial sector of the industry to the specialized needs of the Public Safety sector. In short, Public Safety should be allowed to evolve in the direction of narrowband systems as long as they meet reasonable standards of spectral efficiency, but they should not be allowed to dictate the pace of technological change for other users.

¹⁷ See the Question and Answer note ("APCO Project 25 - New Technology Standards Project") to members of APCO and NASTD from John Powell, Co-Chairman and Craig M. Jorgensen, Co-Chairman, dated April 22, 1993.

IV. CONCLUSION.

For the reasons stated herein, AMI urges the Commission to adopt 5 kHz rather than 6.25 kHz channel size as the "benchmark" for the channelization plans for all of the bands at issue in this proceeding.

Respectfully submitted,
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